

cise and, therefore, has more chance of success in the long-term study of the significance of fish grouping behavior than have the more traditional biological methods used by ecologists and evolutionists. He suggests that "... without invoking any biological notions ..." he can go further in the analysis of the fundamental aspects of fish social behavior than can those workers who concentrate on such things as the survival value of schooling. Here he would seem to be overstating his case. It must be admitted that there are many casual and subjective interpretations of the functions of fish schools in the literature, but not all biologists interested in this problem have been subjective to the point of impotency. Most modern behaviorists are careful to confine their analyses within the limits of well-established biological principles. It is hard to believe that the social behavior of fish can be adequately analyzed solely on the basis of physical and mechanical principles, without involving some "biological notions".

This possible overemphasis on mechanical explanations does not, however, detract from the freshness and originality of the paper. Breder's concepts are based on long and extensive experience with the problems of fish sociology, and with such a solid background his novel method of analysis is sure to attract interest. Also, in spite of his obvious liking for objective mathematical analysis, Breder does not ignore biological principles altogether. His paper ends with the speculation that natural selection may have been the vital factor that allowed schooling behavior to evolve from more primitive forms of fish social organization.

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THE PHYSIOLOGY OF FISHES. Ed. by Margaret E. Brown. Volume 1, *Metabolism*; Volume 2, *Behavior*. Academic Press Inc., New York. 1957. v. 1, 447 pp., figs., tables, \$12.00; v. 2, 526 pp., figs., tables, \$14.00.

This work represents an effort to bring together the large and very widely scattered body of information dealing with fish physiology. In all, the two volumes consist of 24 review articles, each by a specialist in the particular field treated.

Volume 1 is devoted largely to reviews of various organ systems and their functions. The most extensive chapter deals with respiration of both aquatic and air-breathing fishes. This chapter, together with that on the alimentary canal and digestion, comprises nearly one-third of the volume. Other articles are devoted to excretion and osmoregulation, skin and scales, endocrine organs, gonads and reproduction, and the cardiovascular system. Discussions of early development and hatching, experimental studies on growth, and the biochemical composition of fish are the respective subjects of the last three chapters.

The second volume is dominated by thorough treatments of the nervous system, sense organs, and behavior. The latter subject is dealt with in three parts: conditioned responses, ethological analysis of fish behavior, and reproductive and parental behavior.

Three short chapters are given to specialized organs of fishes: the swimbladder, electric organs, and luminous organs. The volume is completed with sections on pigments, color changes, water-quality requirements and effects of toxic substances, and physiological genetics.

This ambitious task has been approached in a fairly careful manner. The various sections have been well integrated, as evidenced by the minimal amount of repetition. Furthermore, a good representation of appropriate references is provided in most cases. Particularly well handled in regard to general organization and clear exposition of presently unanswered problems are the chapters on digestion, endocrinology, the nervous system, and behavior. The discussions of water-quality requirements, growth studies, and biochemical composition should be particularly interesting to the experimental worker. This is also true of the section on physiological genetics, which points up the importance of heredity as a factor to be controlled during experimentation by the use of inbred stocks.

As the editor points out in her preface, the subtitle of each volume is "used in a very broad sense". This comment is even more applicable to the title. The large amount of space devoted to anatomy, histology, and behavior suggests that physiology is practically synonymous with zoology. The extra-physiological material might be considered more as an unexpected blessing had other areas not been underplayed. However, two subjects which should have rated chapter headings are practically ignored—muscle physiology and intermediary metabolism. The latter important field is mentioned only secondarily in regard to endocrine functions and development of the egg and embryo. As a result, the significance of the chapter dealing with the biochemical composition of fish is left largely to the imagination of the reader. Muscle physiology is not discussed at all. If little work has been carried out in these fields (a condition which is especially true in the case of intermediary metabolism), the correspondingly large void in information should be clearly outlined in a book which purports to indicate "gaps in knowledge and possible fruitful lines for further research".

The many excellent presentations which have been incorporated into this work make it an essential reference for those who have a special interest in functional studies of fishes. The two volumes represent the most complete accumulation of information of this kind. Furthermore, because of the considerable quantity of general information on fish zoology which has been included in *The Physiology of Fishes*, it also warrants the attention of the general fish or fishery biologist.

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FISHING AMONG THE INDIANS OF NORTHWESTERN CALIFORNIA. By A. L. Kroeber and S. A. Barrett. (Anthropological Records, Vol. 21, No. 1). University of California Press, Berkeley, Calif. 1964. 210 pp., 49 figs., 32 plates, 74 maps. \$4.50.